

## CLAIMS

1. Apparatus for cleaning a window of a vehicle, comprising:  
a vessel, having an inlet through which a washing fluid is received from a reservoir and  
an outlet through which the fluid is discharged for cleaning the window; and  
5 a heating element for heating the fluid in the vessel, which element preheats the vessel  
before the washing fluid is received therein, whereby at least an initial quantity of the fluid is  
rapidly heated and discharged from the vessel.
2. Apparatus according to claim 1, wherein the vessel is at least partly drained of fluid held  
therein before the element preheats the vessel.
- 10 3. Apparatus according to claim 2, wherein the vessel includes a drain valve, actuated in  
cooperation with operation of the heating element, through which the vessel is at least partly  
drained.
4. Apparatus according to claim 3, wherein the drain valve comprises a one-way valve.
5. Apparatus according to claim 2, wherein the fluid drains into the reservoir, substantially  
15 irrespective of the height of the reservoir relative to the vessel.
6. Apparatus according to claim 1, and comprising a pump, which conveys the fluid from  
the reservoir to the vessel after the element preheats the vessel.
7. Apparatus according to claim 6, wherein the pump and the reservoir are part of a pre-  
existing window cleaning system in the vehicle, into which the vessel and heating element are  
20 retrofitted.
8. Apparatus according to claim 6, wherein the rapid heating of the initial quantity of the  
fluid causes the fluid to be discharged at a pressure substantially higher than a pressure  
generated by the pump at the inlet of the vessel.
9. Apparatus according to claim 1, and comprising one or more valves, which regulate  
25 passage of fluid through the vessel responsive to operation of the heating element.
10. Apparatus according to claim 9, wherein the one or more valves open and close in  
cooperation with operation of the heating element.
11. Apparatus according to claim 9, wherein the one or more valves comprise a solenoid  
valve.

12. Apparatus according to claim 9, wherein the one or more valves comprise at least one of a hydraulic, a pneumatic and a vacuum valve.
13. Apparatus according to claim 9, wherein at least one of the one or more valves is fixed to the inlet of the vessel.
- 5 14. Apparatus according to claim 9, wherein at least one of the one or more valves is fixed to the outlet of the vessel.
15. Apparatus according to claim 14, wherein the at least one valve fixed to the outlet opens responsive to a pressure increase in the vessel, due to contact between the fluid and the preheated vessel.
- 10 16. Apparatus according to claim 1, and comprising one or more temperature sensors, which generate signals responsive to an operating temperature of the apparatus, and a controller, which receives the signals and regulates discharge of the fluid from the vessel responsive thereto.
- 15 17. Apparatus according to claim 16, wherein after the initial quantity of the fluid is discharged, one or more additional quantities of fluid are refilled into the vessel and discharged therefrom intermittently, responsive to the temperature signals.
- 20 18. Apparatus according to claim 17, wherein the quantities are discharged when the temperature signals indicate that the temperature of the fluid in the vessel is above a predetermined threshold, and the discharge is interrupted when the temperature of the fluid falls below the threshold.
19. Apparatus according to claim 17, wherein the quantities are controlled according to a predetermined timing sequence, which is selected responsive to the temperature signals.
20. Apparatus according to claim 16, wherein the controller analyzes the signals to detect a malfunction of the apparatus and interrupts operation of the heating element when the  
25 malfunction is detected.
21. Apparatus according to claim 16, wherein at least one of the one or more temperature sensors is inside the vessel.
22. Apparatus according to claim 21, wherein the at least one sensor is substantially immersed in the fluid in the vessel.

23. Apparatus according to claim 21, wherein the at least one sensor is positioned so as to be substantially out of the fluid in the vessel while the heating element preheats the vessel.
24. Apparatus according to claim 21, wherein operation of the heating element is interrupted when the temperature inside the vessel exceeds a predetermined maximum.
- 5 25. Apparatus according to claim 16, wherein at least one of the one or more temperature sensors is fixed on an outer surface of the vessel.
26. Apparatus according to claim 16, wherein at least one of the one or more temperature sensors is fixed to the reservoir.
27. Apparatus according to claim 16, wherein at least one of the one or more temperature  
10 sensors is fixed on an outer surface of the vehicle.
28. Apparatus according to claim 27, wherein the at least one temperature sensor is fixed on an outer surface of the window to be cleaned.
29. Apparatus according to claim 28, wherein the at least one temperature sensor is covered by an at least partially reflective cover, so as to substantially neutralize the effect of solar  
15 radiation thereon.
30. Apparatus according to claim 27, wherein the fluid in the vessel is heated to a temperature which is varied responsive to the signals generated by the at least one sensor fixed on the outer surface of the vehicle.
31. Apparatus according to claim 1, wherein the vessel comprises an inner compartment  
20 communicating with the outlet, in which compartment the heating element is positioned, and an outer compartment, generally surrounding the inner compartment, communicating with the inlet.
32. Apparatus according to claim 31, wherein the vessel comprises an insulating outer envelope substantially surrounding the outer compartment.
- 25 33. Apparatus according to claim 31, wherein the vessel comprises a wall between the inner and outer compartments, which is preheated by the heating element.
34. Apparatus according to claim 1, and comprising a pressure relief valve.
35. Apparatus according to claim 1, and comprising a bypass line, bypassing the vessel, through which the fluid is conveyed to clean the window without heating the fluid.

36. Apparatus according to claim 35, wherein when cleaning of the window is required while fluid is not available from the vessel, the fluid is diverted through the bypass line.

37. Apparatus according to claim 35, wherein an operator of the vehicle selects whether the fluid is to be conveyed through the bypass or through the vessel.

5 38. Apparatus according to claim 1, and comprising a remote input device, which is actuated by a user of the vehicle to initiate preheating of the vessel before starting the vehicle.

39. Apparatus according to claim 38, wherein the remote input device actuates a wiper to wipe the fluid from the window.

10 40. Apparatus according to claim 1, wherein the heating element comprises a resistive heating wire.

41. Apparatus according to claim 1, wherein the heating element conveys heat from a heat source in the vehicle to the fluid in the vessel.

15 42. Apparatus according to claim 1, wherein the heating element comprises a plurality of elements, at least one of which comprises a resistive heating wire and another of which conveys heat from a heat source in the vehicle to the fluid in the vessel.

43. Apparatus for cleaning a window of a vehicle, comprising:

a vessel, having an inlet through which a washing fluid is received from a reservoir and an outlet through which the fluid is discharged for cleaning the window;

a heating element for heating the fluid in the vessel;

20 a temperature sensor, which senses a temperature in the vessel; and

a valve for controlling flow of the fluid through the vessel, which intermittently releases quantities of the fluid through the outlet at a desired temperature, responsive to the temperature sensed by the sensor.

25 44. Apparatus according to claim 43, wherein a windshield wiper is activated intermittently to clean the window responsive to the intermittent release of the fluid.

45. Apparatus according to claim 43, and comprising a controller, which regulates the intermittent release of the fluid according to a given timing sequence.

46. Apparatus according to claim 45, wherein the timing sequence is varied responsive to an ambient temperature in the vehicle.

47. Apparatus according to claim 45, wherein the timing sequence is varied responsive to a temperature of an outer surface of the window.

48. Apparatus according to claim 43, wherein an initial quantity of the fluid is released at a substantially higher pressure than subsequent quantities.

5 49. A method for cleaning a window of a vehicle using a washing fluid, comprising:  
preheating a vessel;  
introducing a quantity of the fluid into the preheated vessel, whereby the temperature  
and pressure of the fluid are elevated; and  
discharging the fluid onto the window at the elevated temperature and pressure.

10 50. A method according to claim 49, and comprising draining the vessel of fluid before preheating the vessel.

51. A method according to claim 49, wherein introducing the fluid comprises pumping the  
fluid into the vessel, wherein the elevated pressure at which the fluid is discharged is  
substantially greater than a pump pressure generated at an inlet of the vessel due to the  
15 pumping.

52. A method according to claim 49, and comprising measuring a temperature of the fluid,  
wherein discharging the fluid comprises controlling the fluid discharge responsive to the  
temperature measurement.

53. A method according to claim 49, and comprising measuring a temperature of an outer  
20 surface of the vehicle, wherein discharging the fluid comprises controlling the fluid discharge  
responsive to the temperature of the outer surface.

54. A method for cleaning a window of a vehicle using a washing fluid, comprising  
repeating a plurality of times in sequence the steps of:

heating a quantity of the fluid;  
25 monitoring a temperature of the quantity of the fluid; and  
discharging the quantity when a predetermined condition on the heating of the fluid is  
satisfied.

55. A method according to claim 54, wherein the predetermined condition is satisfied when  
the temperature of the quantity of the fluid reaches a selected level.

56. A method according to claim 54, wherein the predetermined condition is satisfied when a predetermined period of time has elapsed since beginning the heating.

57. A vehicle windshield de-icing apparatus comprising: a plurality of individual heating units; and a multi-jacketed housing wherein each jacket surrounds one of the heating units, the jackets being interconnected by fluid conduits, including an inlet and outlet port, the housing being connected at the inlet port to a windshield washer fluid source and at the outlet port to a windshield spray head, the heating units being operated to heat the washer fluid during flow to the windshield spray head, the heated sprayed fluid providing a windshield de-icing effect.

58. An electrically powered windshield de-icing device for vehicles, comprising a heatable container for windshield washing fluid connectable between a washing fluid reservoir and a spray head opposite the windshield, and provided with an inlet port and an outlet port for the fluid, and having an electric heater element disposed inside the heatable container, the remaining liquid capacity of the heatable container not exceeding 300 ml, the heater element being connectable to the vehicle battery and being sized to heat the fluid contained in the heatable container to de-icing temperature within no more than one minute of actuation.